Space Weather Technical Forecast

Issued on Monday, 31 July 2023 at 13:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 Blackouts likely throughout. G1-G2 Minor/Moderate storms possible day 2 (01 Aug) with CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one M-class flare, reaching M1.6 at 31/0900 UTC from AR3390 in the southeast. This is a small and unremarkable region, although there is the possibility of hidden complexity due to its oblique viewing angle. There are now eleven sunspot regions on the disc. Of these only two are magnetically complex. AR3380 in the SW has been analysed Dac/Beta-gamma and AR3386 in the NE is Ehi/Beta-delta. While both of these regions have shown evidence of growth neither have been active. The delta configuration within 3386 is weak. The other regions remain largely small and simple at the present time.
No new Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1, started the period around 510 km/s, before easing to around 460km/s as the Coronal Hole High Speed Stream weakens. Density remained below or near average. The total interplanetary magnetic field was weak as was the north-south component. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained below S1. GOES16 high energy (greater than 2MeV) electron flux reached moderate levels at the diurnal maximum, peaking at 591 pfu at 30/1615 UTC. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu) on a declining trend. 1.47e7 integrated pfu was recorded at 31/0000UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is likely to remain Moderate with further M-flares, these most likely from AR3380 or AR3386. An increase is suggested later in the period, with the possible return of ex-AR3363 indicated on far side seismographs.

Solar Wind / Geomagnetic Activity: The CME from a filament eruption on 29 Jul is currently forecast to arrive at 01/1000 UTC +/- 9 hours. Solar winds are currently slightly-enhanced, but should continue to ease perhaps to background levels, before the CME arrival. Another coronal hole, CH31/-, may give an enhancement towards the end of Day 4 (03 Aug), but this is perhaps more likely after the end of this period.
Geomagnetic activity is expected to be Quiet to Unsettled at first. The CME arrival, most likely early on Day 2 (01 Aug), is expected to give Active to G1/Minor Storm conditions with a chance of G2/Moderate Storm intervals. These conditions gradually easing through Day 3 (02 Aug) to become mostly Quiet, perhaps with some Unsettled to Active intervals later on Day 4 should the HSS from CH31 arrive.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is now below the S1 level, and is likely to continue easing to background levels. There is a slight chance of a further enhancement to S1 with the CME arrival on Day 2 (01 Aug), before returning to background. There is a slight chance of further enhancement from any other notable flares that occur. The high energy electron flux (greater than 10 MeV) may see a brief enhancement to high levels on Day 1 and again on Day 4 (31 Jul and 03 Aug), with a drop out likely due to the anticipated CME arrival on Day 2 (01 Aug). The associated fluence is most likely to remain below the Active threshold (1e8 total pfu), but with a slight chance of rising above, mainly late Day 1 into early Day 2 and on Day 4.

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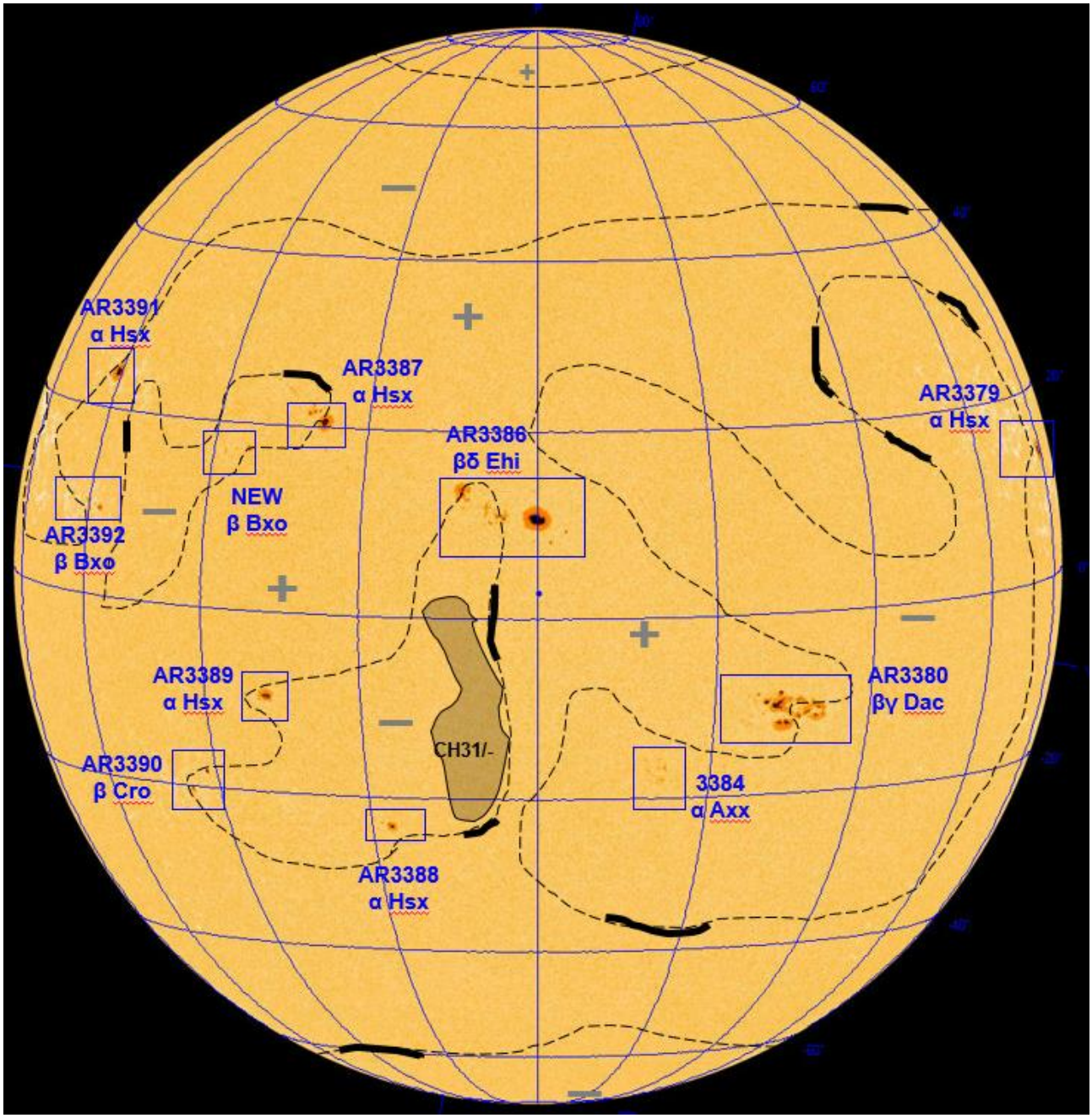
Figure 1. Solar Analysis Valid 31/0700UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one Earth-directed CME, due to a filament eruption from the northeast quadrant on 29 Jul. This is currently forecast to arrive at 01/1000 UTC +/- 9 hours, however recent faster solar winds than indicated in models suggest the potential for an earlier arrival rather than a later one. Current solar winds have become enhanced, likely due to the arrival of the HSS from an obscured coronal hole, CH30/+. This can best be seen on SDO aia-193 imagery, when it was positioned in the centre disc (early on 26 Jul). Elevated winds have started to ease and are likely to ease further, perhaps to background levels, before the CME arrival. Another obscured coronal hole, CH31/-, may give an enhancement towards the end of Day 4 (03 Aug), but this is perhaps more likely after the end of this period.

Geomagnetic activity is expected to be Quiet to Unsettled at first. The CME arrival, most likely early on Day 2 (01 Aug), is expected to give Active to G1/Minor Storm conditions with a chance of G2/Moderate Storm intervals. These conditions gradually easing through Day 3 (02 Aug) to become mostly Quiet, perhaps with some Unsettled to Active intervals later on Day 4 should the HSS from CH31 arrive.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	60	20	5
Strong	G3	No	5	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/0550	Partial	Filament eruption	NE	505km/s	01/1000UTC +/_ 9 hours	Arrival considered more likely earlier than later.

Figure 2: MOSWOC Enlil

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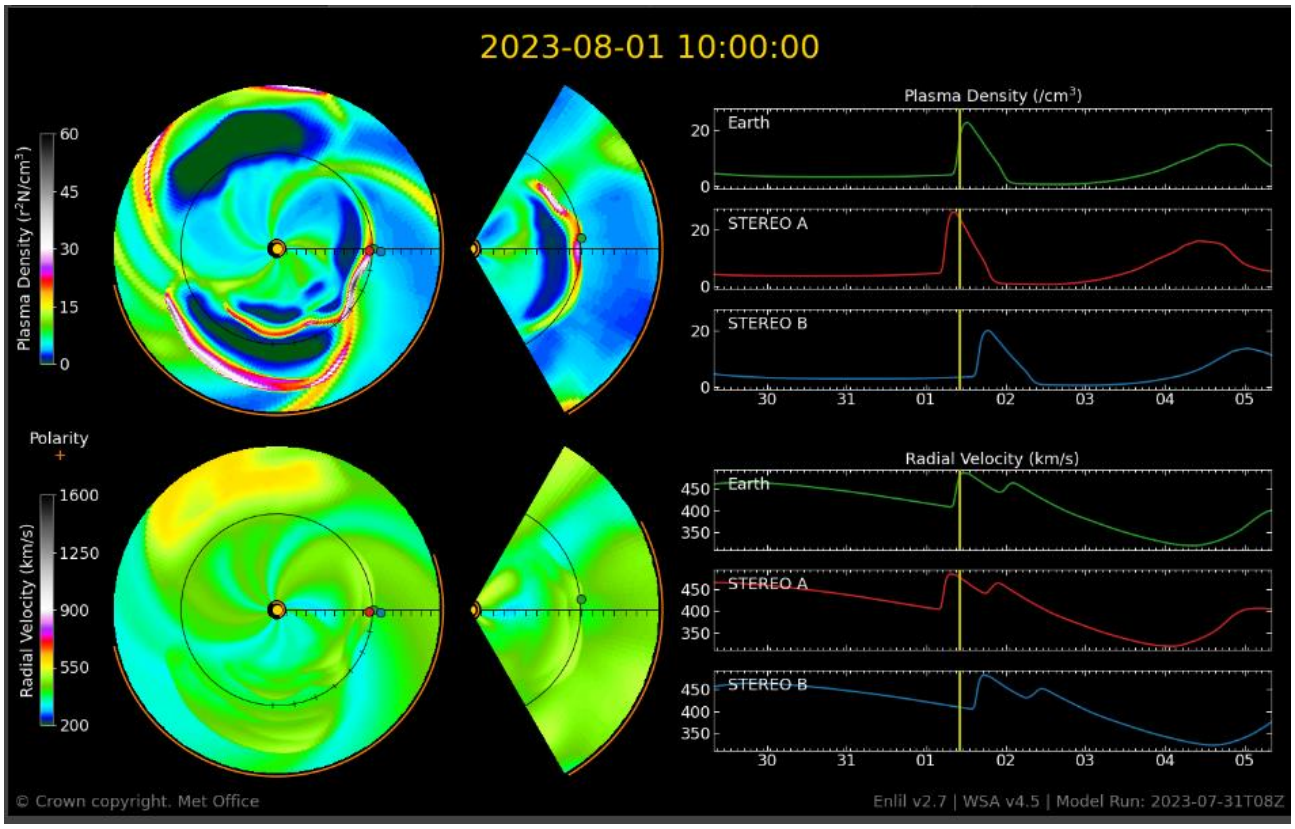

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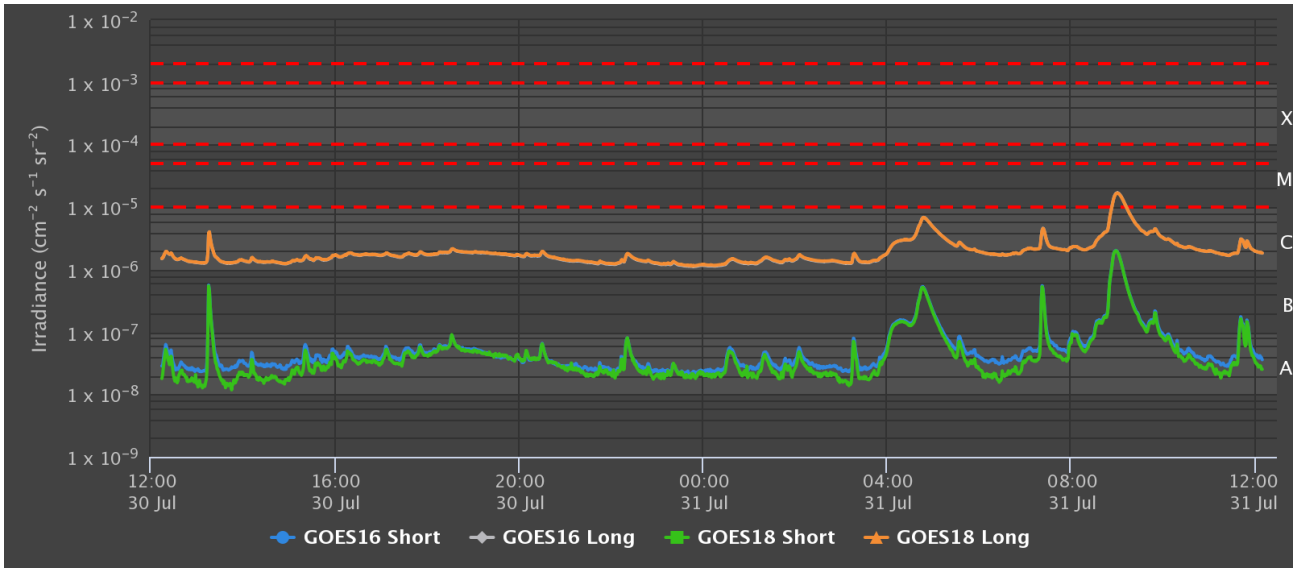
Radio Blackouts - X-Ray Flares:
There are currently eleven sunspot regions on the disc. Despite its relatively simple appearance, AR3390 in the southeast has been the most active of the regions. AR3380, in the southwest, has continued to grow, developing into a more compact region with mature penumbra across a number of spots. AR3386 continues to show a couple of very small delta spots within the intermediate spots. The other regions remain largely small and simple at the present time. M-flares are considered likely throughout.
No major regions are expected to depart the disc during this period. However, far side seismographs suggest a potentially significant region to rotate onto the southeast limb in the near future, perhaps on Day 3 (02 Aug). This would correspond with ex-AR3363 which gave several M-flares on the previous rotation. It is difficult to assess the likely activity level of this region until it becomes visible on the disc, however at this time a slight uptick in flare probability is suggested.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	70	70
Very Active	R3 to R5 X Class	No	5	5	10	10

Figure 3:GOES16 X-Ray flares



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux has remained below the S1/Minor Storm level during the last 24 hours. Proton flux is expected to continue erratically declining during Day 1 (31 Jul), likely to normal background levels. The arrival of the expected CME on Day 2 (01 Aug) has a slight chance to bring a brief re-enhancement to S1 levels before a more general decrease towards background is likely to follow into Day 3 (02 Aug).
There is also an ongoing slight chance of further enhancement due to any significant flares from the two larger regions on the disc, AR3380 already in the western hemisphere and AR3386 which is soon to move into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	10	20	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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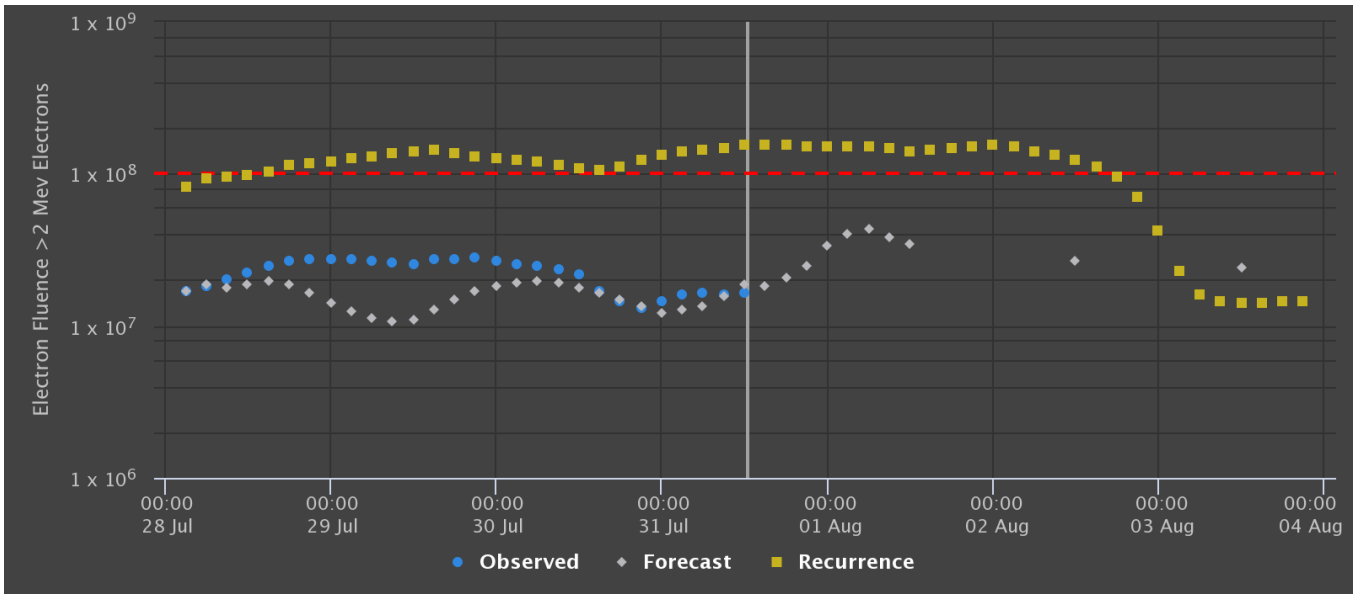
High Energy Electrons Event (≥ 2MeV):
There is a chance that High energy (greater than 2 MeV) electron flux may reach high levels (above 1000 pfu) on Day 1 (31 Jul), before a drop out in observed flux becomes likely due to the anticipated CME arrival on Day 2 (01 Aug). Flux then most probably rising again later in the period, again perhaps reaching high levels.
Despite likely periods of moderate to high flux, the associated 24 hour integrated fluence is expected to remain below the Active (1e8 integrated pfu) threshold for much of this period. The main chances of approaching this level will be late Day 1 or early Day 2, then again on Day 4 (03 Aug). MOSWOC REFM is likely to be providing poor guidance, as it won't be taking into account any CME influence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	20	5	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM



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